Long-Term Global Market Correlations

Global Linkages Pre-onference

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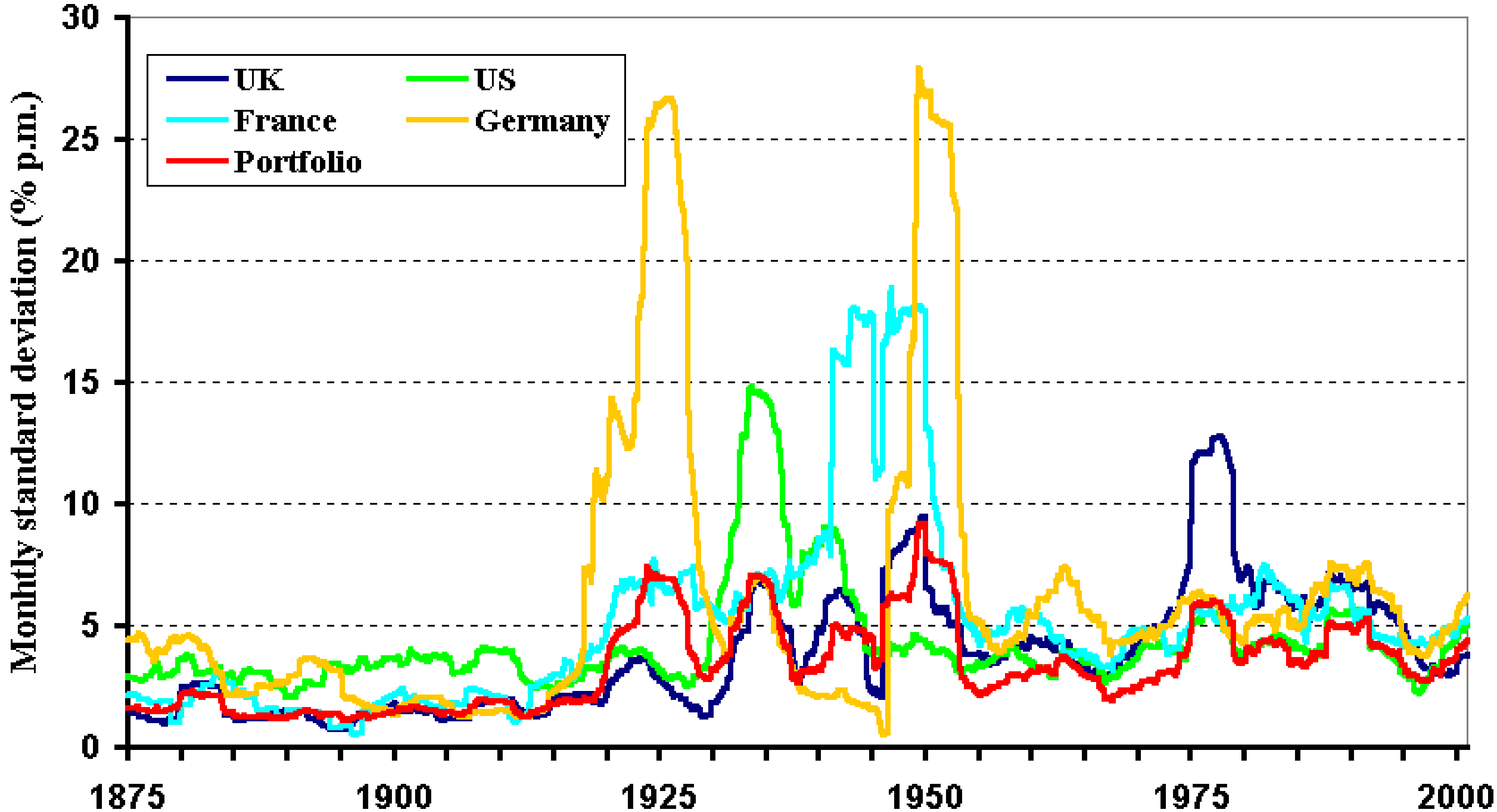
Long-term USD Return Volatility

Four "Core" Markets and EW portfolio



Henry Lowenfeld, 1909

"It is significant to see how entirely all the rest of the Geographically Distributed stocks differ in their price movements from the British stock. It is this individuality of movement on the part of each security, included in a well-distributed Investment List, which ensures the first great essential of successful investment, namely, Capital Stability."

From: *Investment and Exact Science, 1909.*

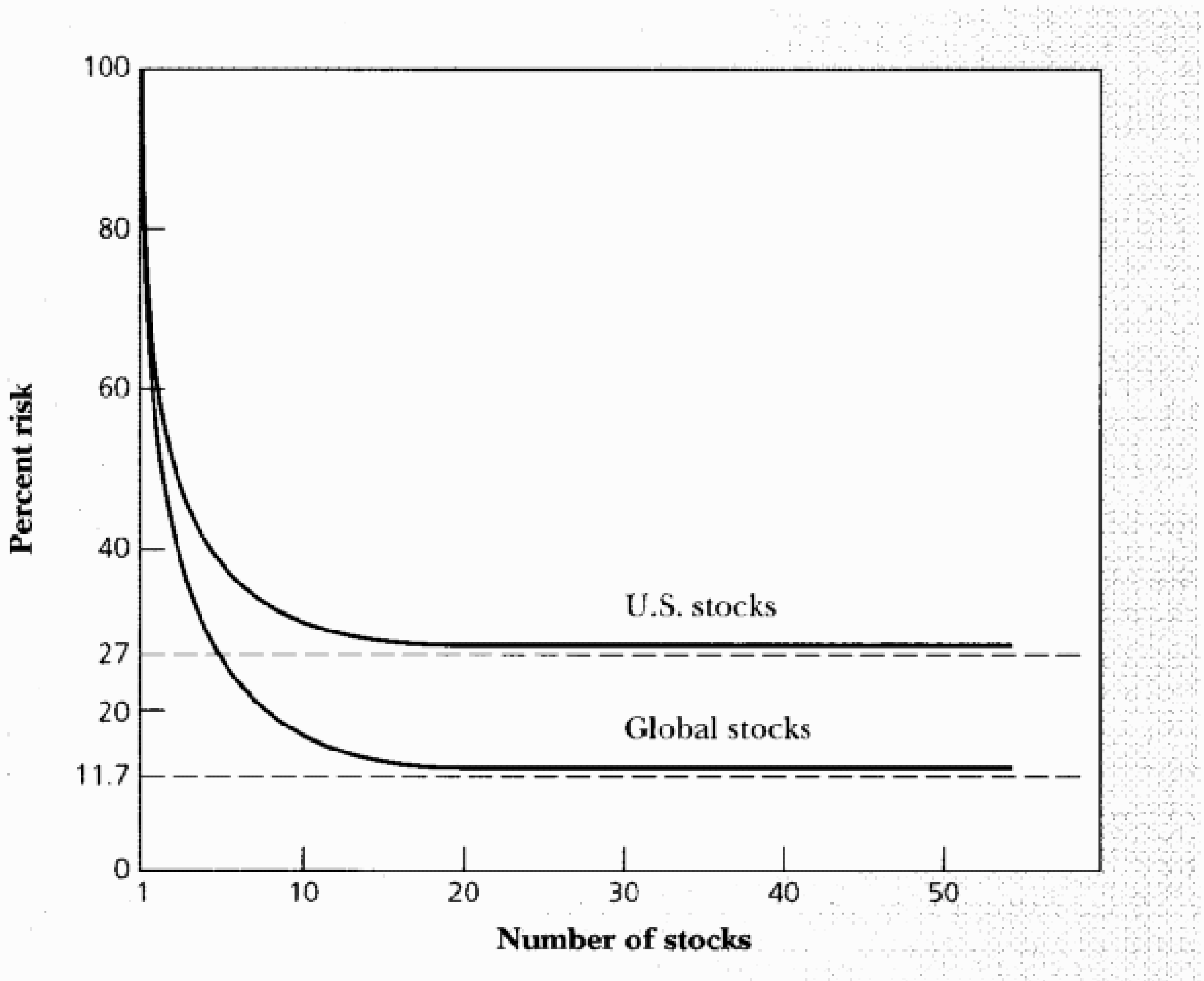
History of Diversification

- First Mutual Fund: *Eendracht Maakt Magt (1774)*
  - Danish and Viennese banks
  - Danish Tolls and Holstein
  - Russia and Sweden
  - Brunswick and Mecklenburg
  - Postal services of Saxony
  - Spanish Canals of Taouste and Imperial
  - British Colonies
  - Essequebo
  - Berbice
  - Danish American Islands

Diversification: First Mutual Funds

- In the portfolio construction the fund “will observe as much as possible an equal proportionality”
- “Because nothing is completely certain, but subject to fluctuations, it is dangerous to allocate all capital to a single security”
- “Nobody will have reason to believe that all securities will stop paying off at the same time thereby losing the entire invested capital”

International Diversification



Source: B. Solnik, "Why Not Diversify Internationally Rather Than Domestically," *Financial Analysts Journal*, July 1976. Reprinted

Determinants of Diversification

- Correlation between the assets in the portfolio
  - Take a long-term look at market correlations over time
- The number of assets in the portfolio
  - Markets have disappeared and (re-)emerged over time
- What is the relative contribution of changing correlations and evolution in the investment opportunity set for diversification benefits?

Preview of Results

- Major shifts in correlations through time.
- Correlations are lower during periods of capital market segmentation than during integration.
- Benefits of diversification among core markets are currently lower than in the 1930's.
- Decomposition shows that currently about half the benefits come from opportunity set growth and half from correlation structure of markets.
- Recent globalization has not diminished the diversification benefits for the "average" investor

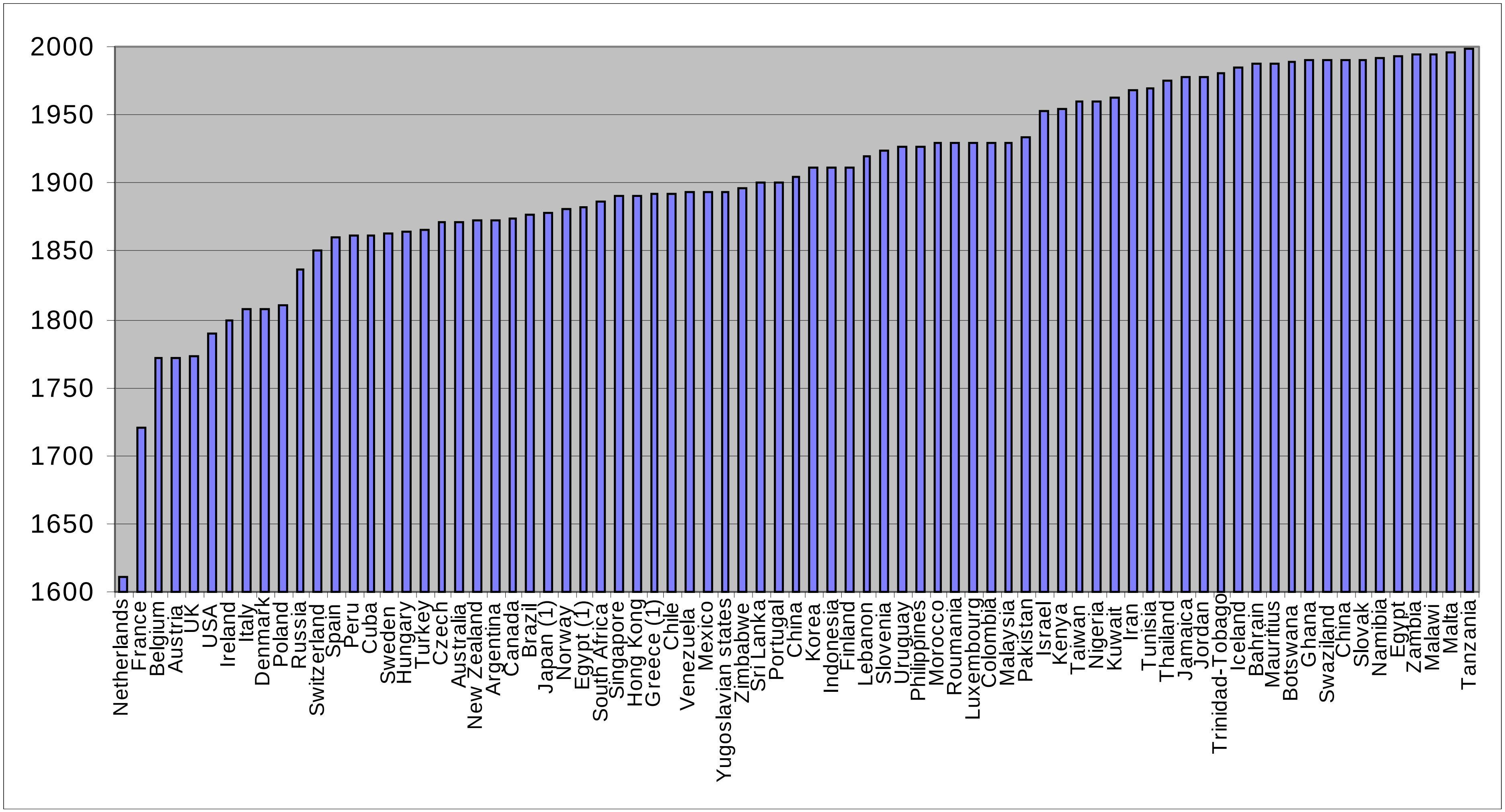
Data

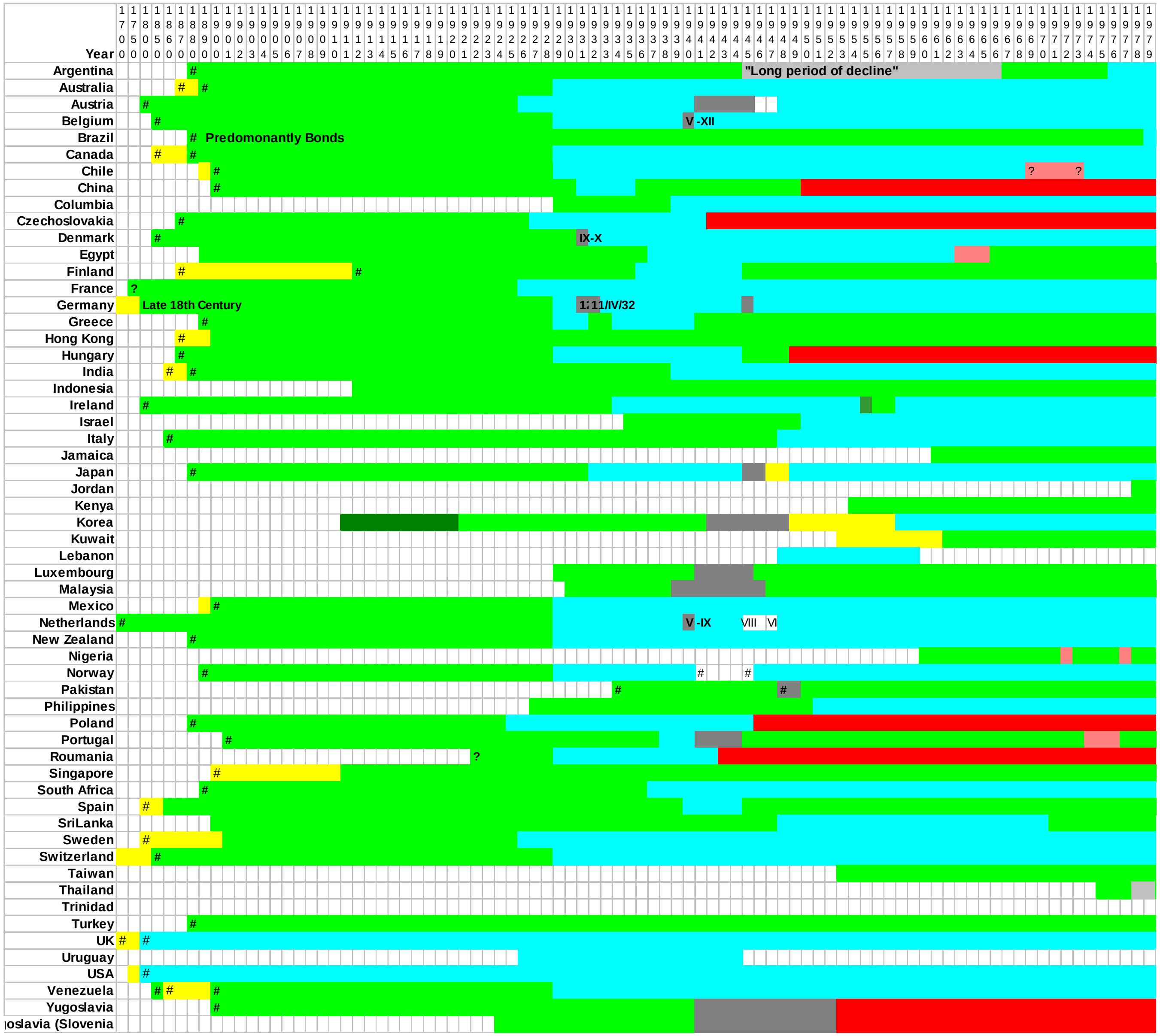
- Monthly equity market index returns for about 50 countries, converted to USD.
- Sources: Jorion and Goetzmann (1999), Global Financial Database, Ibbotson Associates, IFC.
- Simulate perspective of the U.S. based global investor.

Data Issues

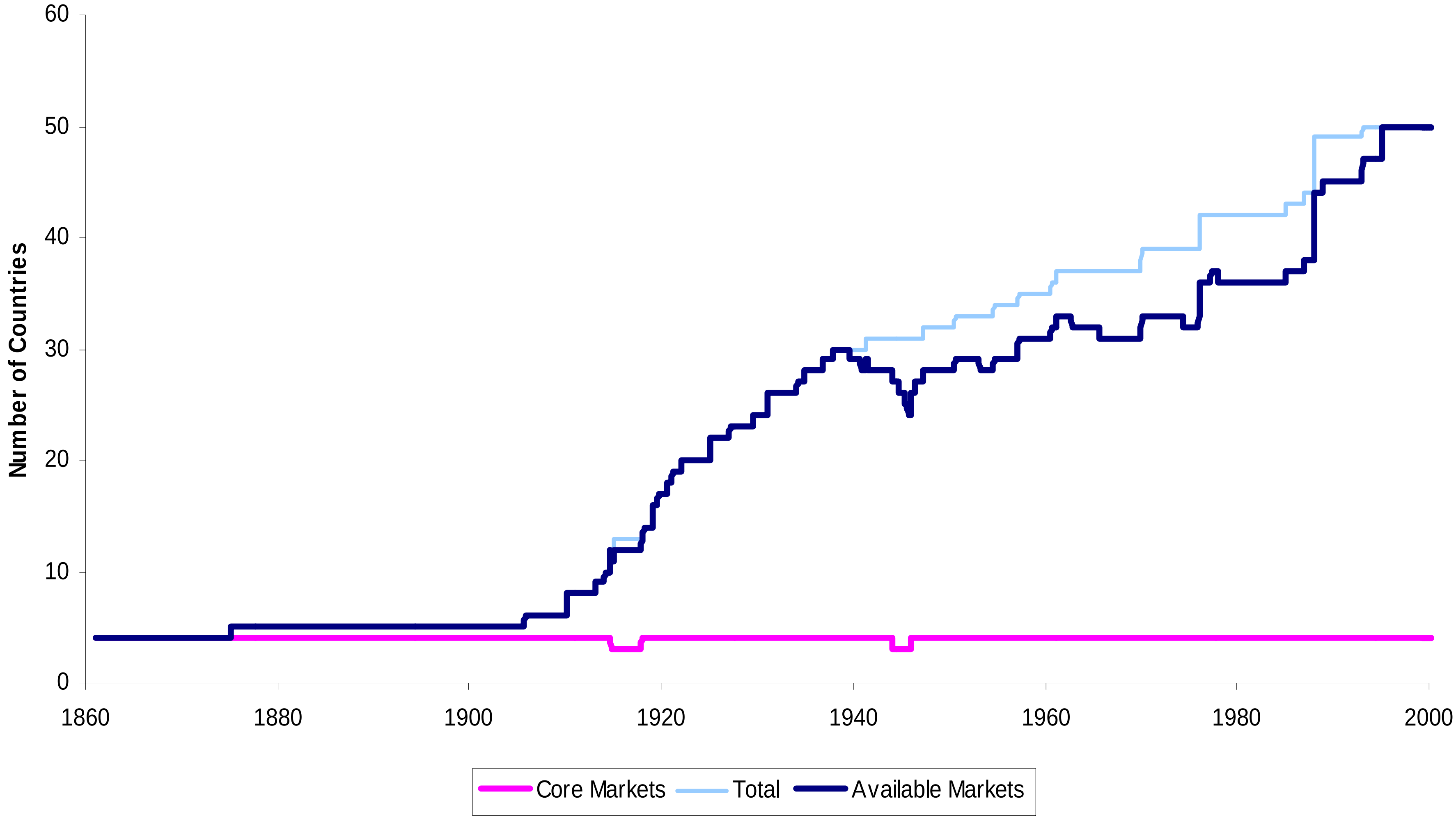
- Missing countries, missing data
  - Little data before 1850
  - Russia in 19th century, China, Japan
  - Dividend information often unavailable
- Which markets were investable and when?
  - Portfolios assume that foreign markets investable
- Transactions costs?
- Prices accurately recorded?
- Cap-weighted vs. equal-weighted?

Founding Dates For World Equity Markets

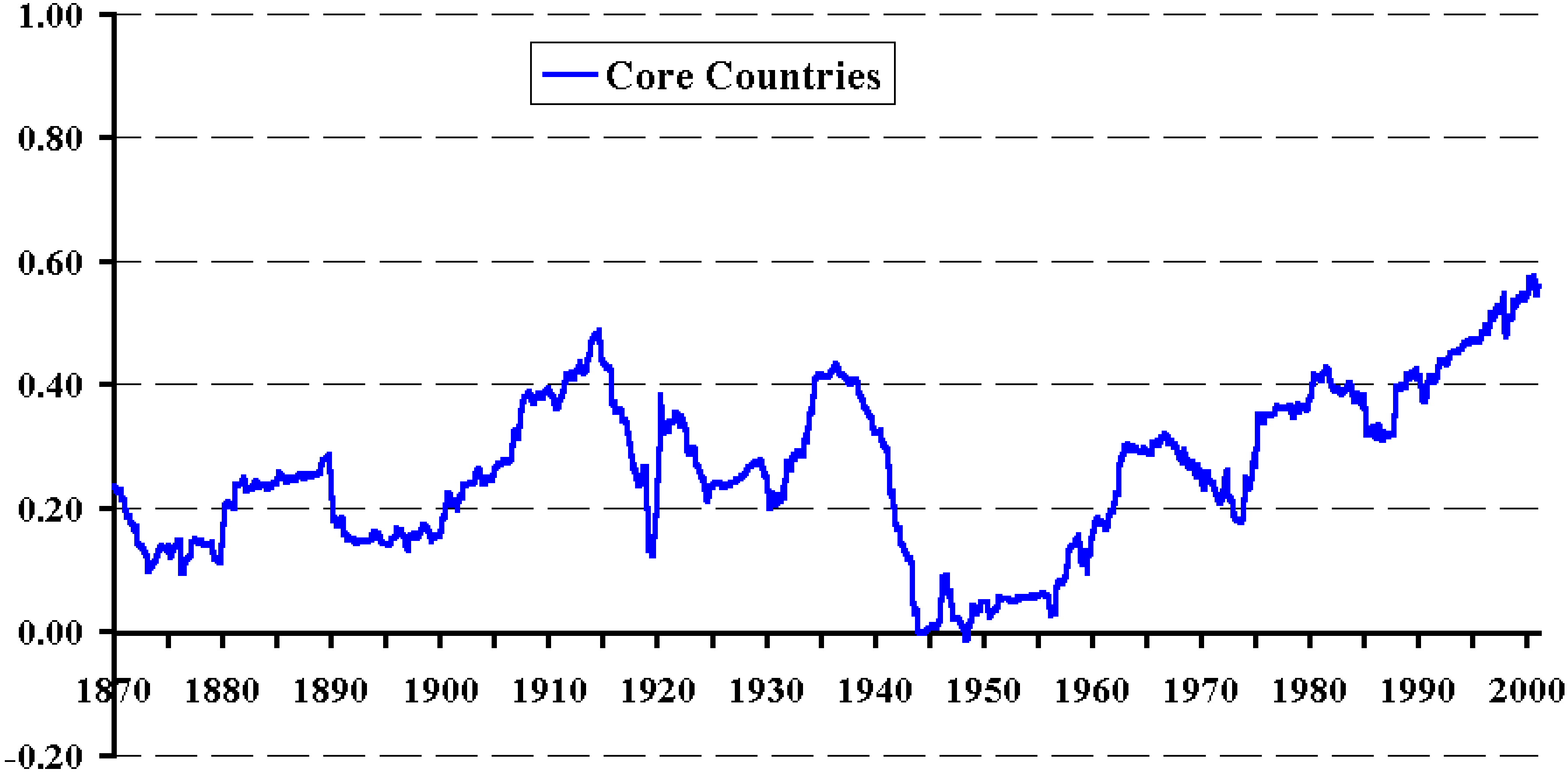



Year
Argentina
"Long period of decline"
Australia
Austria
Belgium
V -XII
Brazil
Predomonantly Bonds
Canada
Chile
?
China
Columbia
Czechoslovakia
Denmark
IX-X
Egypt
Finland
France
Germany
Late 18th Century
11/IV/32
Greece
Hong Kong
Hungary
India
Indonesia
Ireland
Israel
Italy
Jamaica
Japan
Jordan
Kenya
Korea
Kuwait
Lebanon
Luxembourg
Malaysia
Mexico
Netherlands
V -IX
VIII
VI
New Zealand
Nigeria
Norway
Pakistan
Philippines
Poland
Portugal
Roumania
Singapore
South Africa
Spain
SriLanka
Sweden
Switzerland
Taiwan
Thailand
Trinidad
Turkey
UK
Uruguay
USA
Venezuela
Yugoslavia
goslavia (Slovenia

Sample Market Entry and Exit

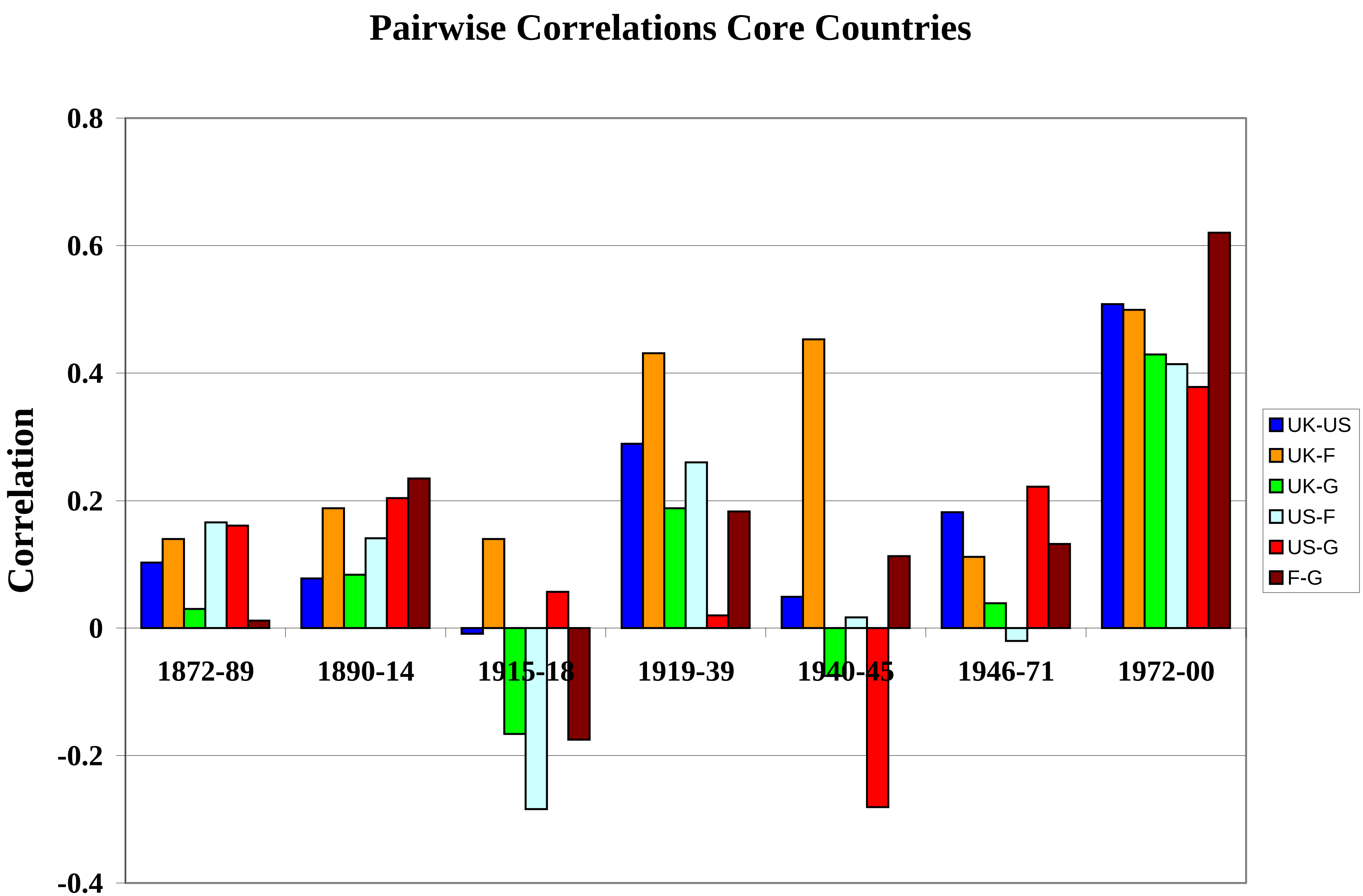


Average Correlation Core Markets
120 month moving average



Basu -Taylor (1999) Episodes

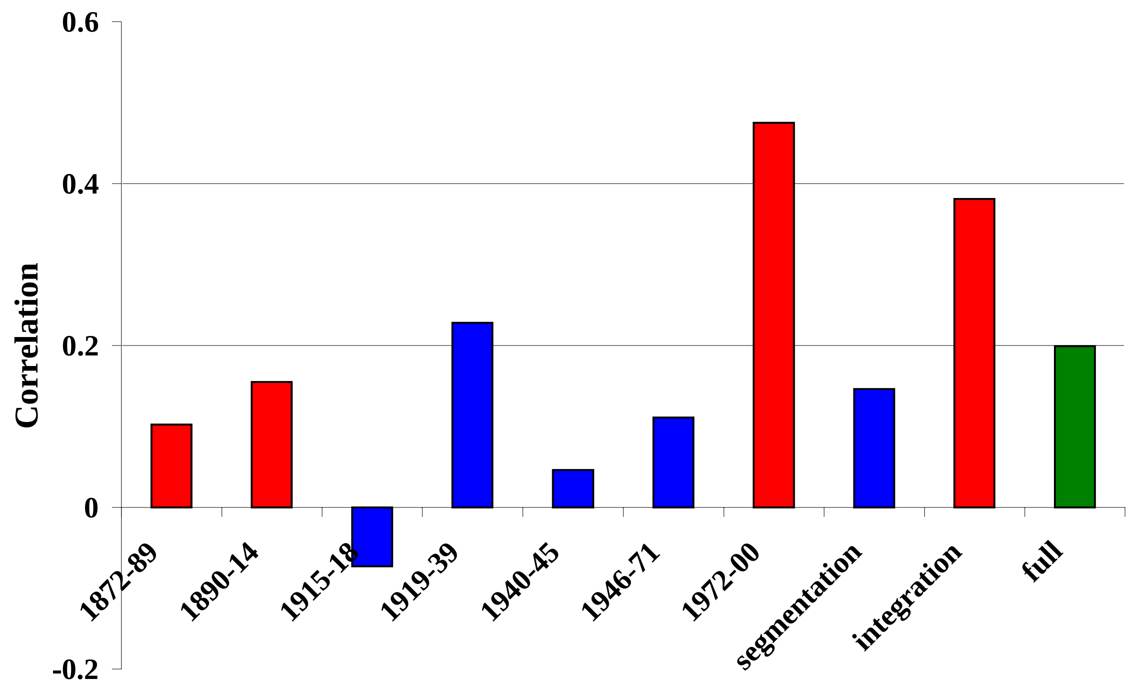
- 1872-1889: Early Integration
- 1890-1914: Turn of the Century
- 1915-1918: World War I
- 1919-1939: Between the Wars
- 1940-1945: World War II
- 1946-1971: Bretton Woods
- 1972-2000: Present



Pairwise Correlations Core Countries
Correlation
0.8
0.6
0.4
0.2
0
-0.2
-0.4
1872-89
1890-14
1915-18
1919-39
1940-45
1946-71
1972-00
UK-US
UK-F
UK-G
US-F
US-G
F-G

Average Correlation

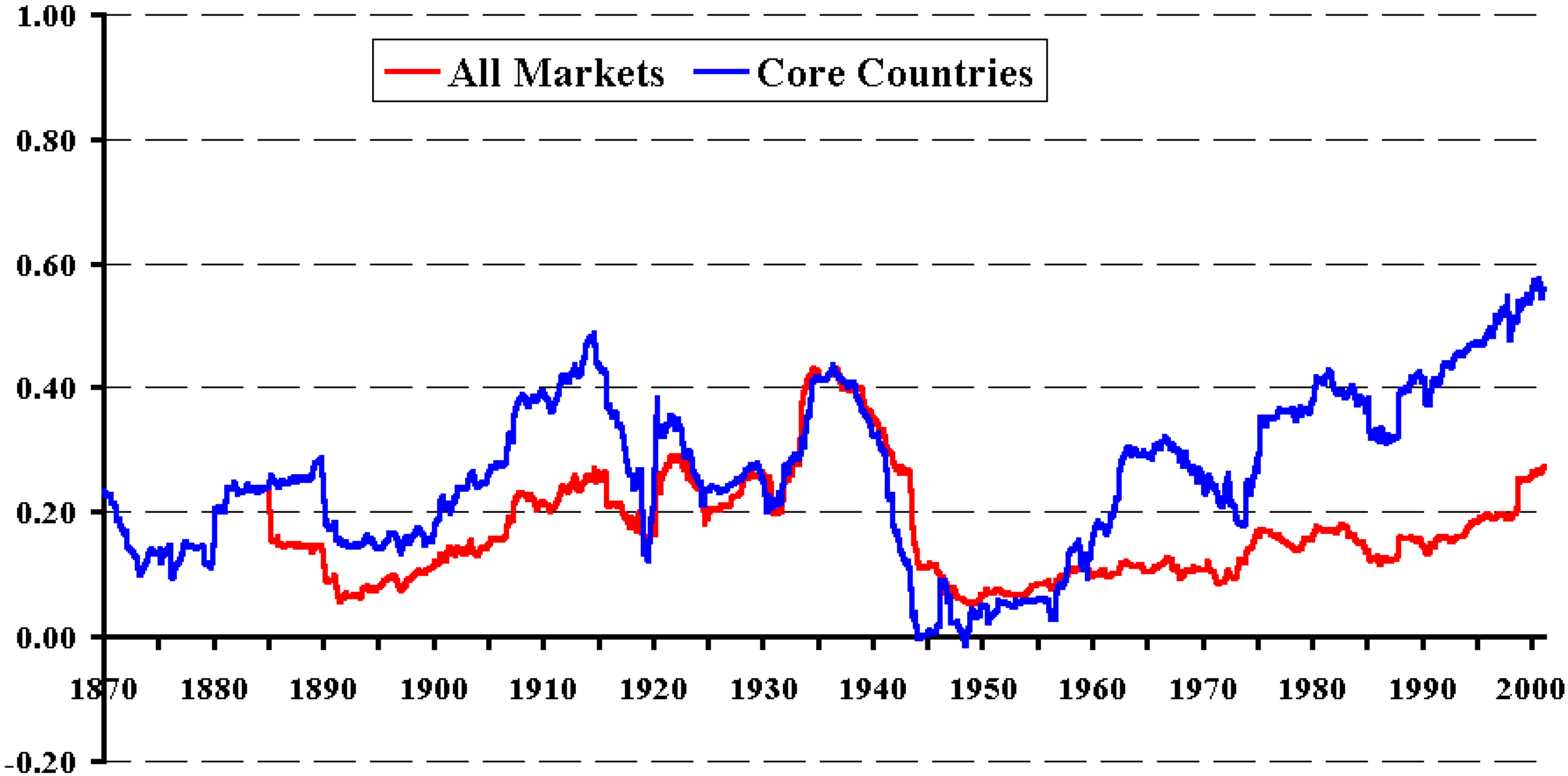
US UK Germany France



Decomposing diversification benefits

- Benefits of diversification extends far beyond core markets
- Recent era shows high average correlation among core markets, but there are currently many more markets available for diversification.
- Does increase in opportunity set compensate for increase in average correlation?

Average Correlation Equity Markets
120 month moving average



Diversification measure - 1

$$\frac{Var\left(\sum_{i=1}^{n} x_i / n\right)}{\frac{1}{n}\sum_{i=1}^{n} Var(x_i)} = \frac{\frac{1}{n^2}\sum_{i=1}^{n} Var(x_i)}{\frac{1}{n}\sum_{i=1}^{n} Var(x_i)} + \frac{\frac{1}{n^2}\sum_{i \neq j}^{n} Cov(x_i, x_j)}{\frac{1}{n}\sum_{i=1}^{n} Var(x_i)}$$

$$= \frac{1}{n} + \left(\frac{n-1}{n}\right) \times \frac{\overline{Cov(x_i, x_j)}}{\overline{Var(x_i)}}$$

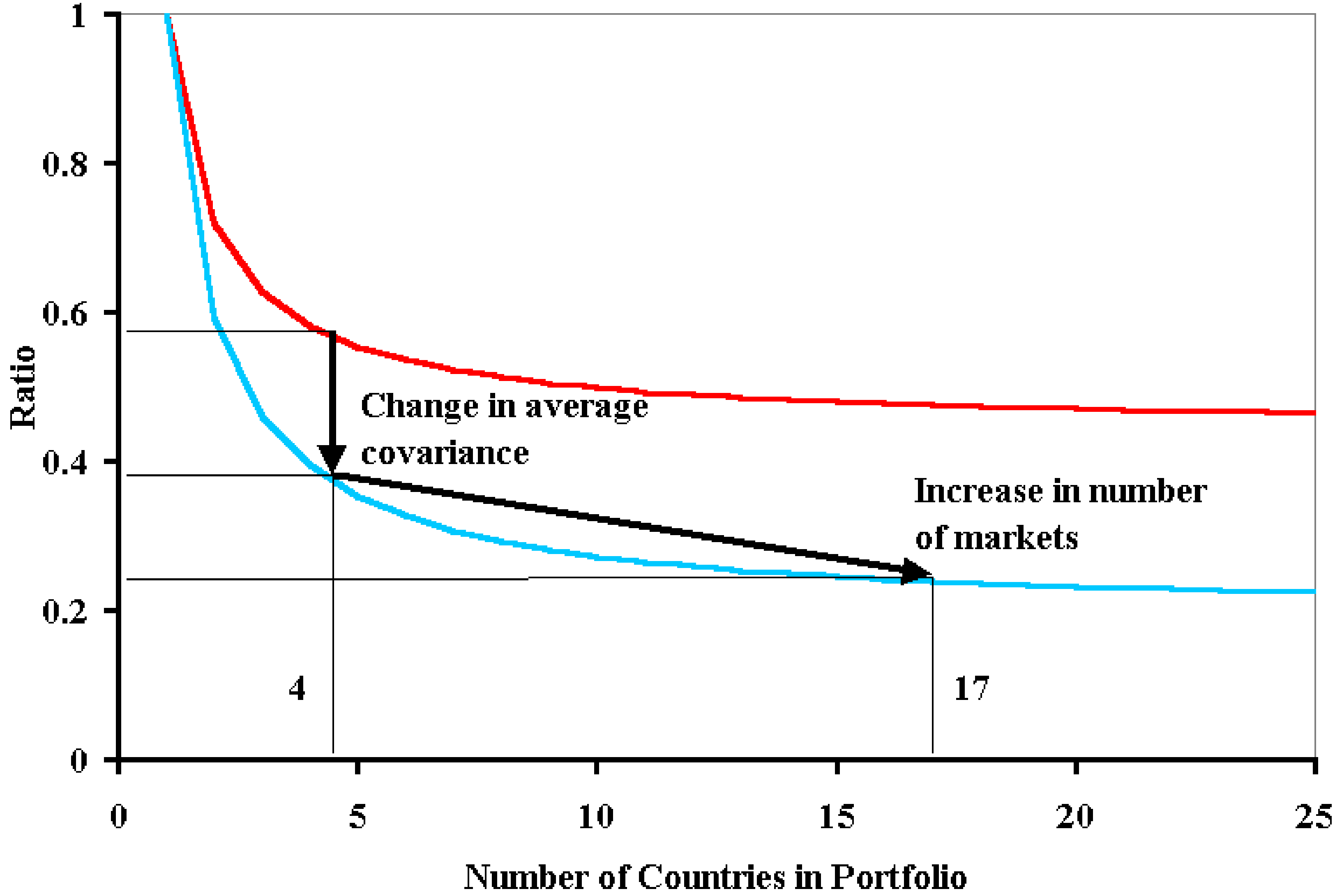
Diversification measure - 2

- Diversification benefits measured by the ratio of :
  - return variance of a diversified portfolio
  - average return variance of the assets in the portfolio

- Ratio lies between 0 and 1 :
  - 1: perfect correlations
  - 0: uncorrelated returns

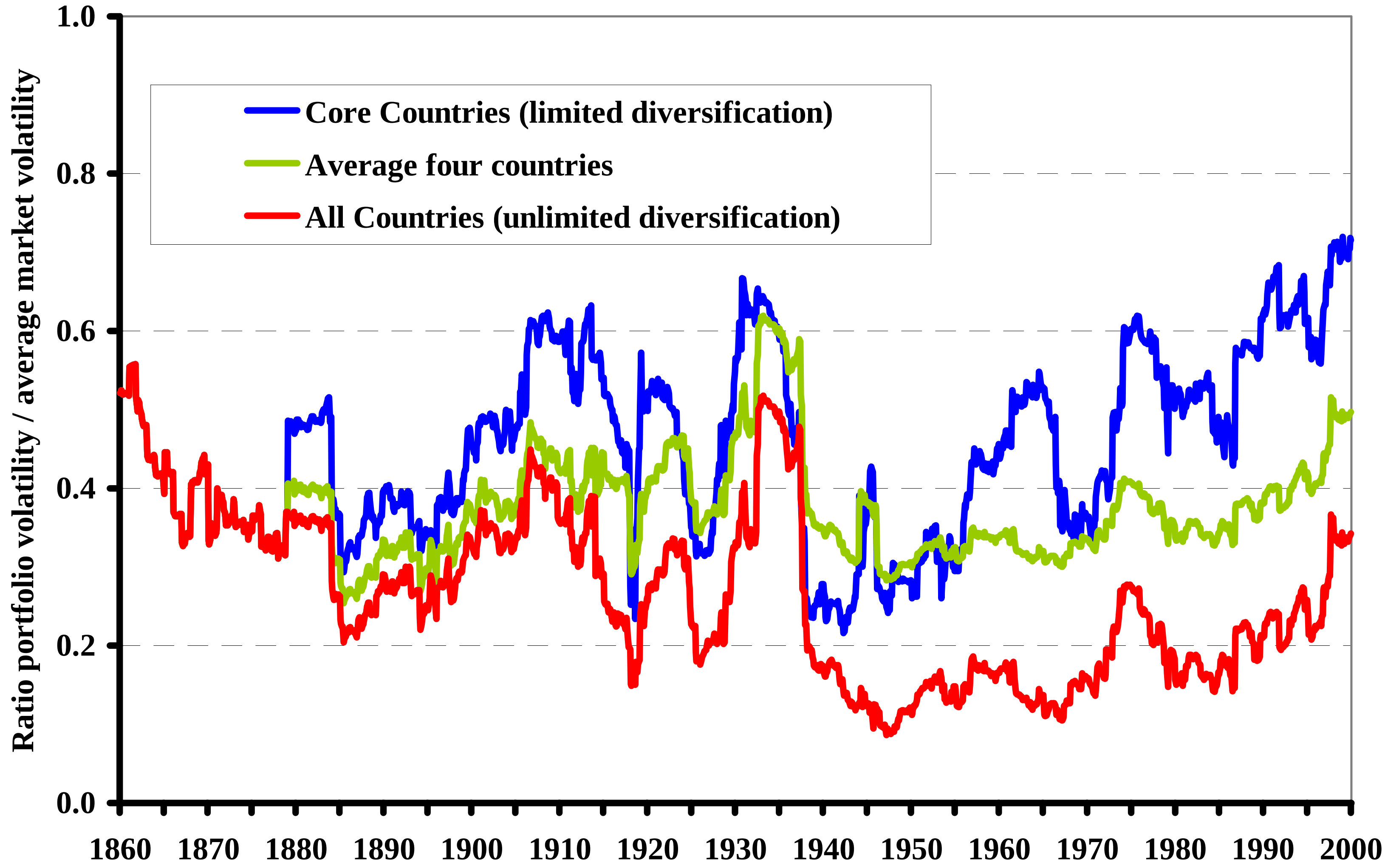
Decomposing the Benefits of International Diversification

Average Covariance versus Investment Opportunity Set



Decomposing the Benefits of International Diversification

equally-weighted portfolio variance / average market variance



Current diversification benefits -1

- Variance of a portfolio of 4 core markets is currently about 70% of the average individual country variance (30% reduction)
- Core markets have higher correlation than emerging markets: average portfolio of 4 markets provides 50% risk reduction
- Maximum global diversification offers 65% risk reduction
- Expansion of opportunity set contributes about half of the total diversification benefits

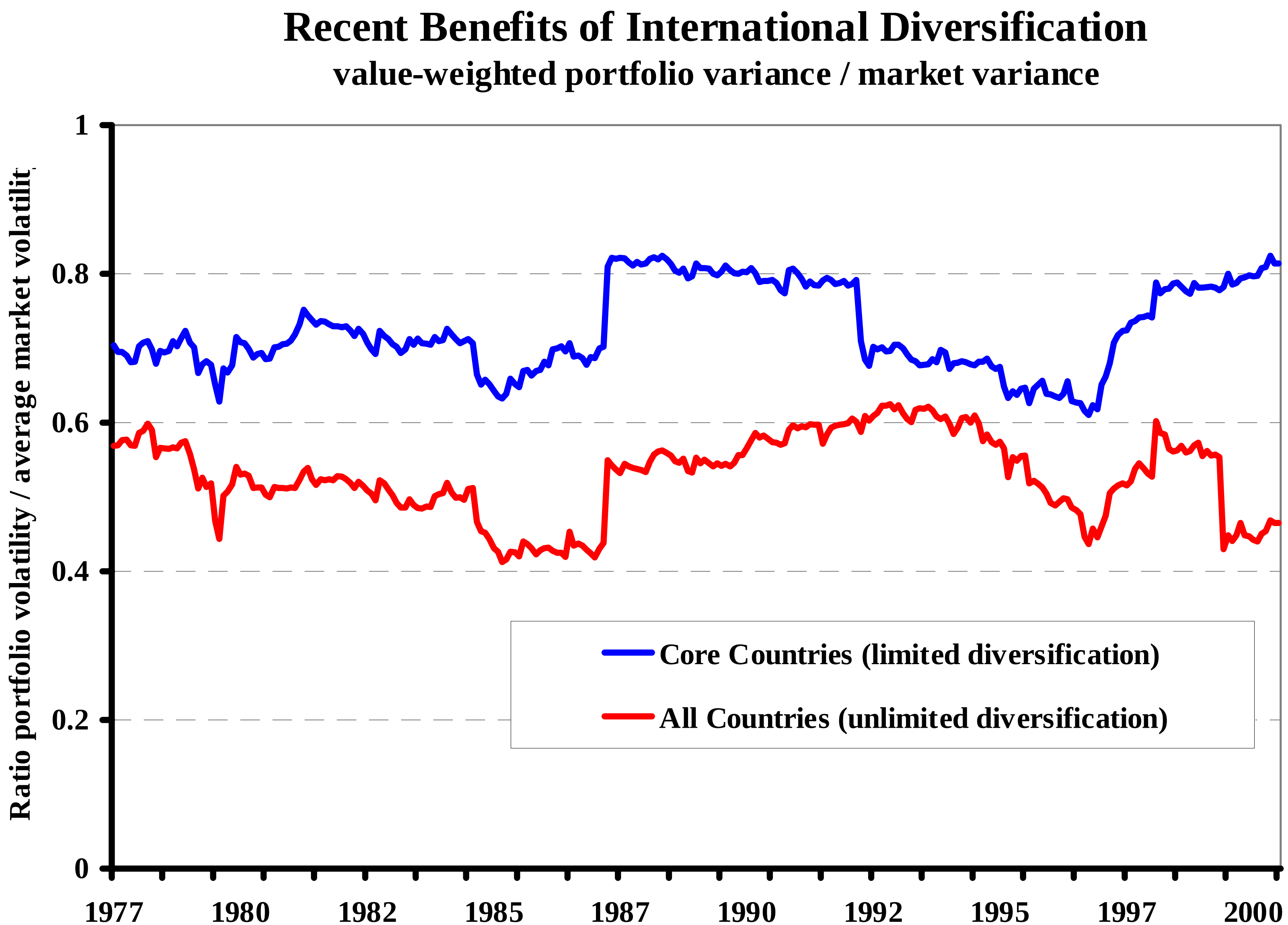
Current diversification benefits -2

- Effect of increase in the investment opportunity set has been twofold:
  - “Emerging” markets have lower correlation than developed markets: risk reduction rises from 30% to 50%
  - The increase in the number of markets: risk reduction rises from 50% to 65%

- Expansion of opportunity set doubles diversification benefits (from 30 to 65%): about half comes from lower correlations have from increase in the number of markets

Equilibrium diversification benefits -1

- Not every investor can hold an equally-weighted portfolio
- Assets have to be held in proportion to market weights
- Weight of smaller/emerging markets needs to be reduced
- What do equilibrium benefits of diversification look like?


Recent Benefits of International Diversification
value-weighted portfolio variance / market variance
Ratio portfolio volatility / average market volatilit
1
0.8
0.6
0.4
0.2
0
1977
1980
1982
1985
1987
1990
1992
1995
1997
2000
Core Countries (limited diversification)
All Countries (unlimited diversification)

Equilibrium diversification benefits -2

- Benefits are generally lower because value-weighted portfolios are less diversified.
- Despite the slow rise in return correlations, the benefits to international diversification have been remarkably stable over last 25 years
- “Emerging markets” double the benefits to diversification across core markets.

Conclusions

- Longer view reveals shifts in correlations.
- Integration is associated with high market correlation
- While correlations are at highpoint in history, investors benefit from an expansion of the investment opportunity set
- About half of current benefits stem from expansion of opportunity set.
- Diversification benefits have been remarkably stable for "average investor" over last 25 years.